BL57-1-2-C-00.xxx
BL57-1-2-C-01.xxx(low speed)

Brushless DC driver

Closed loop

Mod-Bus

User Manual

Rev. 051001

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0. INTRODUCTION

Only qualified personnel should work with the product.
Use the product correctly after thoroughly reading the section "Safety precautions".
The product described in this manual has been designed and manufactured for use in general industrial machinery, and must not be used for any others purpose.
See table beyond to prevent equipment damage.

Protective range	IP52	
Operation environment	Ambient temperature	0°C to +45°C (+32°F to +113°F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000m (9840ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Storage environment	Ambient temperature	-25°C to +70°C (-13°F to +158°F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000m (9840ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Shipping environment	Ambient temperature	-25°C to +70°C (-13°F to +158°F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000m (9840ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil

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0.1 SAFETY PRECAUTIONS

The precautions described below are intended to prevent danger or injury to the user and personnel through safe, correct use of the product. Use th product only after carefully reading and fully understanding these instructions.

WARNING:

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire, electric shock or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and/or troubleshooting the product.
- Do not transport, install the product, perform connection or inspection when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- Provide a means to hold the moving parts in place for applications involving up/down travel. The motor loses holding torque when the power is shut off, or the driver is disable, allowing the moving parts to fall and possibly causing injury or damage to equipment.
- Connect the cables securely according to the wiring diagram in order to prevent fire and electric shock.
- Do not turn Enable off (InEn off = all windings off) while motor is operating. The motor will stop and lose its holding ability, which may result in injury or damage equipment.
- For maintenance and inspection before working on the system, shut off the power to the drive and wait 1 minute. Failure to do so may result in electric shock.
- Do not open, disassemble or modify the drive. Refer all such internal inspections and repairs to the branch or sales office from which you purchased the product.

CAUTION:

- Do not use the drive beyond their specifications, or electric shock, injury or damage to equipment may result.
- Do not touch the drive during operation or immediately after stopping. The surface are hot and may cause a burn.
- Keep the area around the drive free of combustible materials in order to prevent fire or a burn.
- To prevent the risk of damage to equipment, leave nothing around the drive that would obstruct ventilation.
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.
- The motor's surface temperature may exceed 70°C, even under normal operating conditions. If motor is accessible during operation, post a warning label in a conspicuous position to prevent the risk of burns.
- When an abnormality is noted, stop the operation immediately, or fire, electric shock or injury may occur.

1.SYSTEM DESCRIPTION

1.1 OVERVIEW

This product line represents the ideal high tech low cost solution for motor designer who wants to realize motor and drive integration.

Designed for easy installation, the motors supported are:

➔ **Step motor : "ST" family**
➔ **Brushless DC motor : "BR" family**

1.2 KEY FEATURES

- Brushless motor driver with trapezoid profile.
- Hall effect feedback.
- Low speed option
- Single power supply.
- Opto coupled input and output:
  - ✔ 5 Digital input
  - ✔ 2 Digital output
- Standard input = Positive active
- +10V analogue input reference
- Protection :
  - ✔ Volt Max.
  - ✔ Over temperature (electronic area)
  - ✔ I^2t
- Communication link RS485 up to 254 addressing units.
- ModBus protocol to control point to point or multiple units.
- Programming software " I.L." (Instruction List) IEC 1131-3
- Operation mode:
  - ✔ Speed control
  - ✔ Torque control
  - ✔ Pulse movement (step-like)

1.3 GENERAL SPECIFICATIONS

Input voltage (+Vdc)
- Range..... +24 to +60 Vdc

Output current
- Max..... 3,5 Arms

Motor speed limit
- Hall effect feedback Minimum..... 300 rpm
- Option "Low speed" Minimum..... 100 rpm

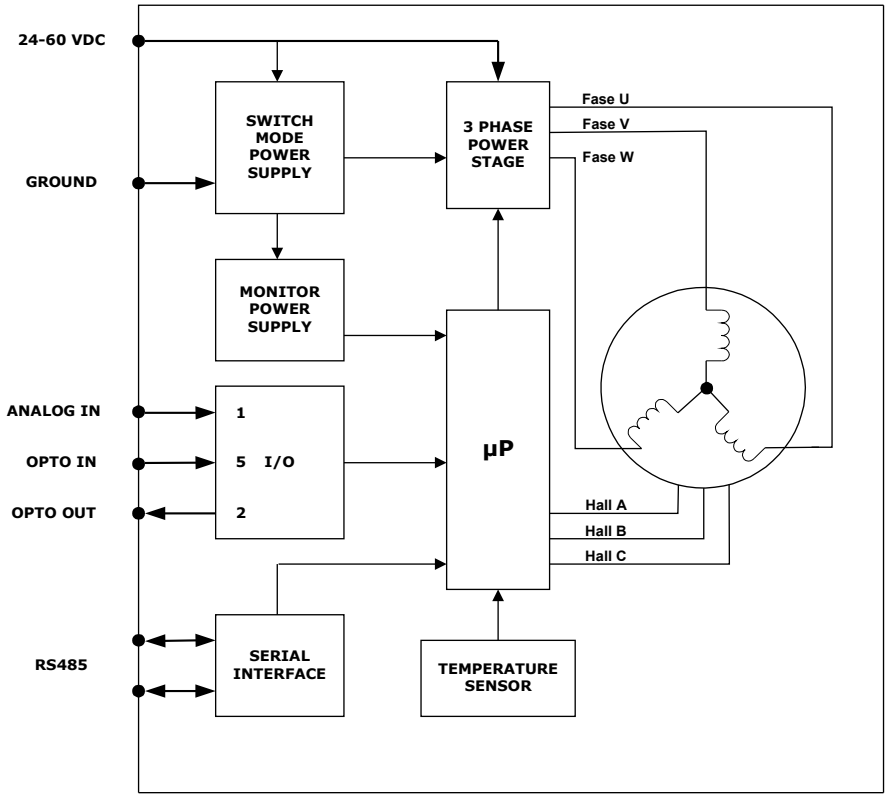
I/O
- 2 opto-coupled high speed digital inputs..... 200 Khz
- 3 opto-coupled low speed digital inputs..... 5 Khz
- 2 opto-coupled digital output..... 3 mA

Analog input
- range..... 0-10 V

Communication
- Differential half duplex RS485
- Protocol..... ModBus
- Baud Rate..... 19200 bps

Protection
- Over voltage..... 86 VDC
- Under voltage..... 18 VDC
- Electronic Temperature..... 85°C

1.4 FUNCTIONAL BLOCK



1.5 POWER SUPPLY

	MIN.	Nom.	MAX.	
Power supply + AT	22	24-60	86	Vdc
Power supply - AT		0		Vdc
Input current I_{nom}		3		Adc
Input current Peak I_p				Adc

Table 1/1

Single power supply, not stabilized DC voltage, required with min. 1.000uF 100V external capacitor (per unit).

1.6 I/O

The **BL5712Cxxx** drive is supplied with a set of :

- ✔ 3 low speed opto coupled input, (In2, In3, In5)
- ✔ 2 high speed opto coupled input, (In1, In4)
- ✔ 1 analog input
- ✔ 2 low speed opto coupled output

Standard positive logic Input (active high).
Provided for two nominal digital input voltage, 24Vdc and 5Vdc (*)
Inputs and outputs functions can be programmed by RS485 , "Instruction List" .
All inputs are protected against inverted polarity connection.

DIGITAL INPUT pin 5-6-7-12-14

		Unit	Min.	Nom.	Max
In1,In2,In3,In4,In5	5 V logic (*)	Vdc	4	5	12
	24 V logic	Vdc	15	24	30
In1, In4	Hi-speed INPUT	mA	-	5	-
In2, In3, In5	Low speed INPUT	mA	-	1,5	-
Frequency	Hi-speed INPUT	KHz	-	-	200
Pulse width		µs	1,5	-	-
Frequency	Low speed INPUT	KHz	-	-	5
Pulse width		µs	100	-	-

(*) On request

Table 1/3

ANALOG INPUT pin 13

	Unit	Min.	Nom.	Max
Input voltage	Vdc	0	-	10
Input impedance	ohm	-	-	40k
Resolution	Bit	-	10	-

Table 1/4

DIGITAL OUTPUT **pin3 - pin4**

	Unit	Min.	Nom.	Max
Voltage	Vdc	-	-	48
Current	mA	-	-	3
Saturation voltage @ 3 ma	Vdc	-	-	1
Leakage current	µA	-	-	50

Table 1/5

1.7 RS485 SERIAL INTERFACE

RS485 serial interface half duplex with Modbus protocol.
It's possible to connect up to 32 drives with a single RS485 converter or up to 254 using a line repeater.

Serial interface parameter:

Baud rate : 19200
Parity : Even
Data bits : 8
Bit stop : 1
Bit start : 1
Line terminator : 120 ohm

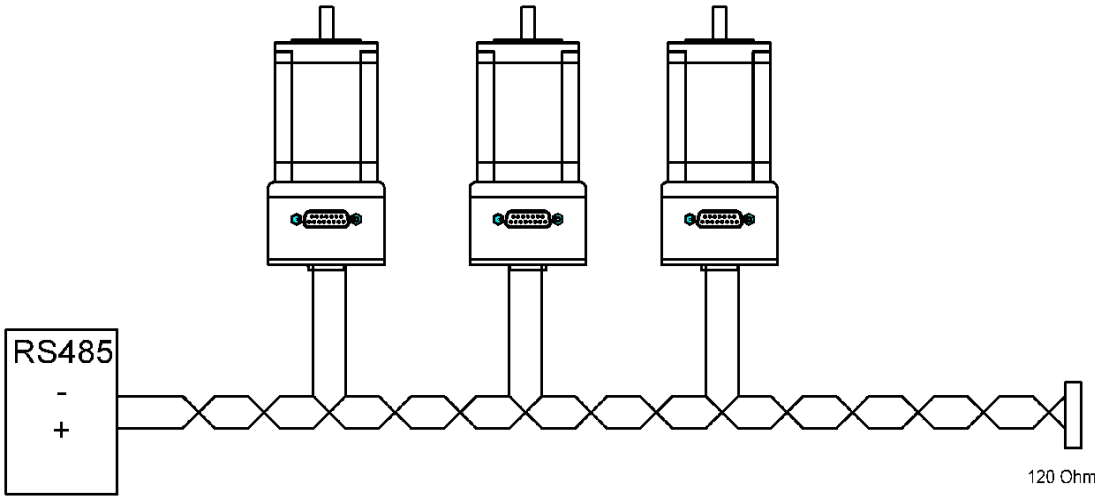


FIG. 3/1 - RS485 parallel connection

***** ATTENTION *****

In parallel connection be sure to have all drives with different identification number.

1.8 INTEGRATED PROTECTION

- ✔ Power supply over voltage protection : 86 Vdc
- ✔ Power supply under voltage limit : 18 Vdc
- ✔ Driver, over temperature protection : ~88 °C
- ✔ I/O protected against reverse voltage.
- ✔ I^2t over current motor protection

1.9 OPTION "LOW SPEED"

The minimum suggested working speed for brushless dc motor with hall effect feedback is 300 rpm.

The option **"Low speed "** with 64 ppr feedback, instead 12, allows to control the motor as low as **100 rpm**.

To order the **"Low speed "** option use code :

BL5712C_**01**

N.B. The lowest speed possible depends on motor quality so difference in low speed limit can occur.

2. CONNECTION AND MECHANICAL DATA

2.1 ELECTRICAL CONNECTION

Drive connector J1

Pin Nr.	Pin Name	Function	Description
1	+ AT	+Vdc	Positive power supply input
2	GND	Gnd	Negative power supply input
3	OUT1	Digital output	Programmable function
4	OUT2	Digital output	Programmable function
5	In1	Fast digital input	Programmable function
6	In2	Digital input	Programmable function
7	In3	Digital input	Programmable function
8	D-	RS485-	RS485-
9	+ AT	+Vdc	Positive power supply input
10	GND	Gnd	Negative power supply input
11	Common	I/O Common	Input/Output Common
12	In4	Fast digital input	Programmable function
13	Ain	Analog input	Programmable function
14	In5	Digital input	Programmable function
15	D+	RS485+	RS485+

Table 2/1

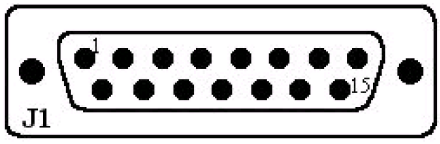


FIG. 2/1 – J1 15 pins Sub-D male.

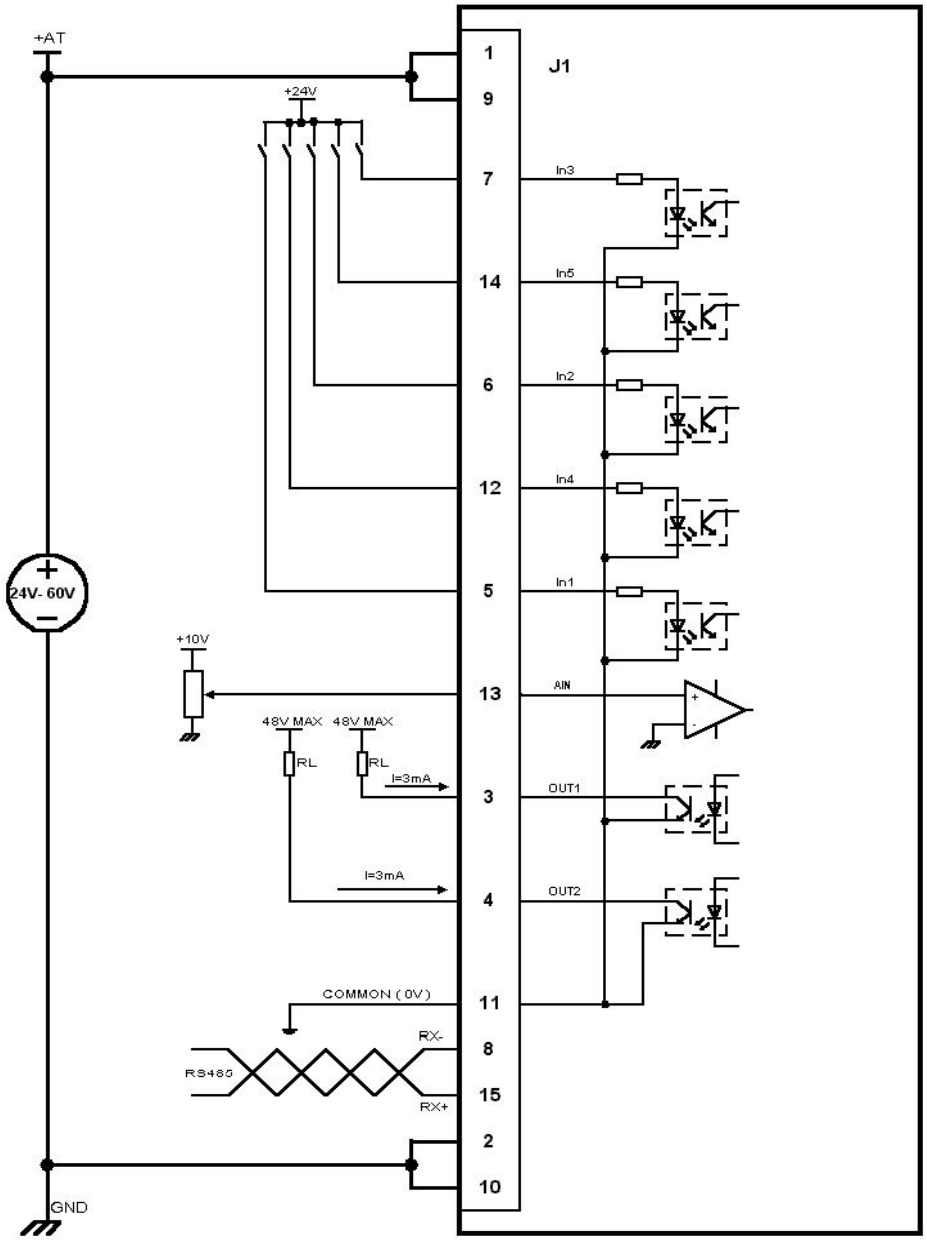


FIG. 2/2 – Wiring diagram

2.2 MECHANICAL DATA

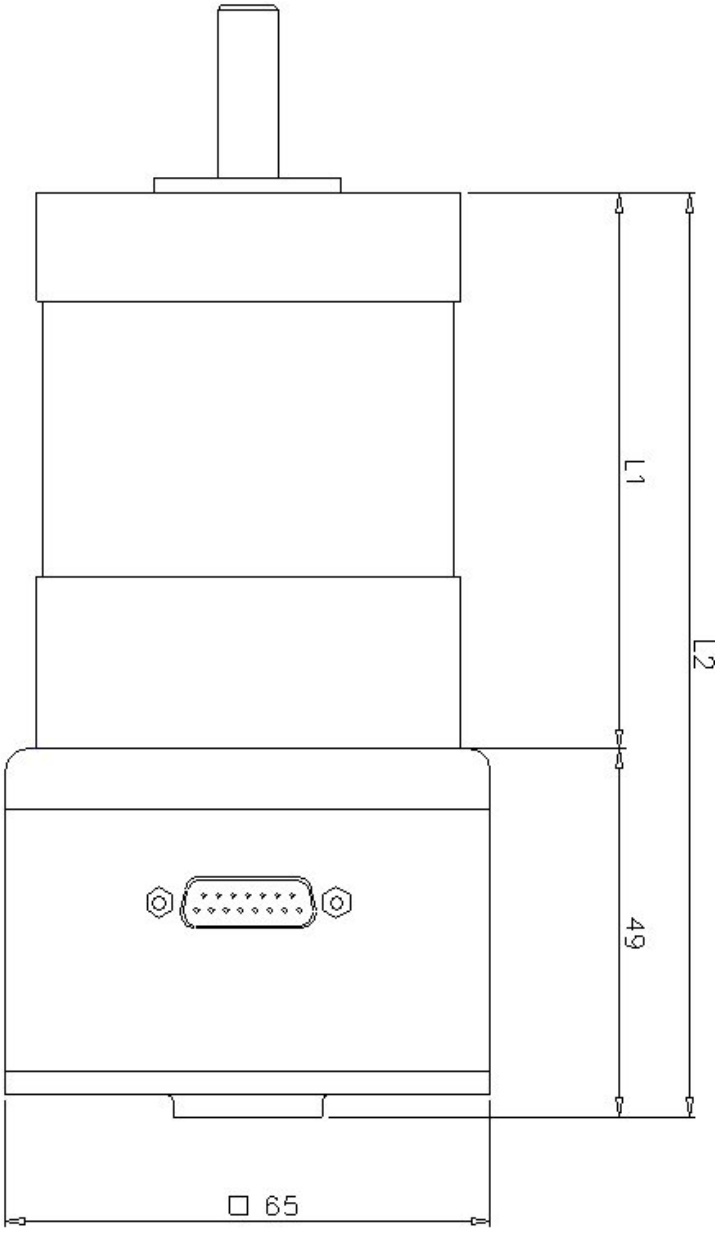


FIG. 2/3 – Mechanical dimension (mm)

3. OPERATIONAL MODE

Motor drive works in different operational mode :

- ➔ **"Stand Alone" external analog speed reference**
- ➔ Internal speed reference and acceleration ramp generator
- ➔ Torque control

The motor drive is supplyed in **"Stand Alone" (default)** operational mode.

3.1 STAND ALONE (default)

"Stand Alone" configuration allows use the driver in speed control with analog speed reference , the connection to RS485 is not required.

To control the motor speed you need only 2 data :

- ✔ Speed reference
- ✔ on / off input

Other common functions implemented are :

- ✔ Limit switch CW
- ✔ Limit switch CCW
- ✔ Direction
- ✔ Drive OK
- ✔ Motor speed value

Default in/out configuration

J1 Pin Nr.	Pin Name	Pin Function	Description
3	**Out1**	**DRIVE_OK**	**Out active=low=drive ok**
4	**Out2**	**MOTOR SPEED**	**Hz vs. Motor speed**
5	**In1**	**FC_CCW**	**Limit switch CCW**
6	**In2**	**FC_CW**	**Limit switch CW**
7	**In3**	**ON/OFF**	**Active=Hight=motor On**
12	**In4**	**DIR**	**Direction=hight=CCW**
13	**Ain**	**Analog speed reference**	**0/+10V = 300/4000 rpm**
14	**In5**	**Acceleration level**	**Active=Hight=max acc.**

Table 3/1

3.2 "STAND ALONE" functions description

Ain = Analog speed reference

The speed reference range **Ain** is :
0 Vdc = 300 rpm (100 rpm with Low speed option)
+10Vdc = 4000 rpm

Internal automatic Acc/Dec ramp set at 6.000 rpm/s^2

In3 = Motor ON

Optoisolated input In3 = Hight (+24V) = motor **ON**
In3 = Low (0V) = motor **OFF**

N.B. To prevent accidentaly start of the motor at the power on, the **ON** input (In3) must be Low to enable the **ON** function.

In5 = Acceleration level

Optoisolated input In5 = Hight (+24V) = maximum acceleration 0 sec
In5 = Low (0V) = acceleration 1 sec

N.B. Maximum acceleration is possible according to max torque/current available.

In1 = Limit switch FC_CCW

Optoisolated input In1 = Hight (+24V) = motor **OFF =**disable CCW direction
In1 = Low (0V) = none

N.B. The limit switch logic function, disable the direction and stop the motor. Only the opposite direction is enable.

In2 = Limit switch FC_CW

Optoisolated input In2 = Hight (+24V) = motor **OFF =**disable CW direction
In2 = Low (0V) = none

N.B. The limit switch logic function, disable the direction and stop the motor. Only the opposite direction is enable.

In4 = Direction DIR

Optoisolated input In4 = Hight (+24V) = enable CCW direction
In4 = Low (0V) = enable CW direction

Out1 = DRIVE_OK

The drive is ready and no protections are active.

Out2 = MOTOR SPEED

A frequency value of motor speed is feedback through Out2 with the following function :

300 rpm = 30 Hz 3.000 rpm = 300 Hz

N.B. **"Stand Alone"** is the default resident program made in Instruction List language.

Is possible to replace or modify it through the RS485 connection, using the **IMide softwere** as show in the Imide softwere manual.

3.2 "STAND ALONE" Instruction List

```
;/*******************************************************/
;/******* Societa'        : SP.EL. s.r.l                 *******/
;/******* File            : default06.il                 *******/
;/******* Data            : 13 lug. 2005                 *******/
;/******* By              : P.L.                         *******/
;/******* Hardware        :                              *******/
;/*******************************************************/
; semplice programma start stop il IL
;
DES Default ..... Brushless serie ....
DES INGRESSI:
DES       IN1 = FINE CORSA ANTIORARIO
DES       IN2 = FINE CORSA ORARIO
DES       IN3 = START_STOP
DES       IN4 = DIREZIONE
DES       IN5 = RAMPA ACCELLERAZIONE SI/NO
DES -
DES  INGRESSO ANALOGICO 10 VOLT = 4000 rpm
;
; Ingressi Fisici
FC_CCW          BOOL  16          ; IN 1
FC_CW           BOOL  17          ; IN 2
START_STOP      BOOL  18          ; IN 3
DIR             BOOL  19          ; IN 4
RAMPA_OFF       BOOL  20          ; IN 5
;
VELOCITA        INT   0
VL_MIS          INT   10    /s
ACC             INT   51    /m
RACC            INT   1     /i
I2T             INT   30

; variabili pid
KP              INT   11    /m
KIF             INT   12    /m
KDB             INT   13    /m
```

```
KIB             INT  14   /i
KDF             INT  15   /m
LFD             INT  17   /i
TIPO_ENC        INT  20   /i
;
;  EMERGENZE
;
MAX_AT          BOOL 6
MIN_AT          BOOL 12    /i
MAX_IT          BOOL 7
TERMICA         BOOL 8
FAULT           BOOL 9     /i
RESET_EMG       BOOL 10    /i
;
ON_MOTORE       BOOL 0     /i
TARGET          BOOL 2     /i
DIREZIONE       BOOL 1     /i
DRIVE_OK        BOOL 21    /i   ; OUT1
OUT2            BOOL 22    /i
TRIG_OSC        BOOL 5     /i   ; AVVIO CAMPIONAMENTO OSCILLOSCOPIO
RESET_EMG       BOOL 10    /i

CK_EXT          INT  40    /i
TIPO_ACC        BOOL 13    /i
POS_TARGET      LINT 2     /i
IN_ANA          INT  8
TIMER           INT  9     /i
TIPO_RAMPA      INT  21    /i
TC_OSC          INT  28    /i   ; TEMPO CAMPIONAMENTO OSCILLOSCOPIO
I_PARTENZA      INT  37    /m
;
; TEST POINT
;
SW_TP           INT  29   /i
TP1             INT  22   /i
TP2             INT  23   /i
TP3             INT  24   /i
;
LIM_CORR        INT  36   /m
COPPIA          INT  39   /i
;
VEL_TMP         INT  58   /i
FIRMA           INT  59   /i
;
;  INIZIO PROGRAMMA
;
MAIN:
      LD   FIRMA
      NE   0
      JMPC NOST
      LD   0
      ST   TIPO_ENC
      LD   10
      ST   I_PARTENZA
      LD   1000
      ST   ACC
      LD   100            ; Kp = 100
      ST   KP
      LD   1              ; Kdf = 1
      ST   KDF
      LD   200            ; Kdb = 200
      ST   KDB
      LD   10000          ; Kib = 10000
      ST   KIB
      LD   50             ; Kif = 50
      ST   KIF
      LD   32             ; LFD = 32
      ST   LFD
      LD   80
      ST   LIM_CORR
```

```
      LD   2
      ST   SW_TP
      LD   905
      ST   FIRMA
NOST:                  ; controlla che non sia in start alla partenza
      LD   1
      ST   TIPO_ACC
      LD   0
      ST   ON_MOTORE
      LD   START_STOP
      JMPC NOST
      CAL  CALC_VEL
ATT_START:
      LD   1           ; segnala su OUT_1 che il motore è ok
      ST   DRIVE_OK
      CAL  CALC_VEL    ; subroutine di calcolo della velocità
      LD   START_STOP  ; attendi pressione tasto START_STOP
      EQ   0
      JMPC ATT_START   ; salta se non premuto
      LD   1
      ST   RESET_EMG   ; resetta eventuali emergenze
      LD   DIR
      ST   DIREZIONE   ; copia direzione
      LDN  DIR         ;
      ANDN FC_CW       ; controlla condizioni Fine Corsa
      OR(  DIR         ;
      ANDN FC_CCW      ;
      )                ; M_OK = !D&!FC_CW | D&!FC_CCW
      EQ   0
      JMPC ATT_START   ; se non ok vai attesa start
      LD   1
      ST   ON_MOTORE   ;  avvia motore
      ST   TRIG_OSC
;
ATT_STOP:              ; ciclo attesa STOP
      CAL  CALC_VEL    ; subroutine calcolo velocità
      CAL  CECK_FC     ; controlla fine corsa
      JMPC NOST        ;
      LD   DIR
      EQ   DIREZIONE   ;
      JMPC NOCD
      LD   DIR
      ST   DIREZIONE   ; copia direzione
      LD   1
      ST   TRIG_OSC
NOCD:
      LD   START_STOP  ; attendi STOP
      JMPC ATT_STOP    ;
      LD   RAMPA_OFF
      EQ   0
      JMPC DEC_L
      LD   0           ; ferma motore
      ST   VELOCITA
      LD   100
      ST   TIMER
      LD   1
      ST   TRIG_OSC
ATT_TIM:
      LD   TIMER
      NE   0
      JMPC ATT_TIM
      LD   0
      ST   ON_MOTORE   ;
      JMP  NOST        ;
;
DEC_L:
      LD   0
      ST   ON_MOTORE   ;
ATT_FR:
      LD   TARGET
```

```
      EQ   0
      JMPC ATT_FR
      JMP  NOST
;
;
CALC_VEL:               ; subroutine calcolo velocità
      LD   RAMPA_OFF
      EQ   1
      JMPC ACC_H
      LD   ACC
      ST   RACC
      JMP  LB00
ACC_H:
      LD   0
      ST   RACC

LB00:
      LD   IN_ANA       ; imposta la velocita controllando
      MUL  1100         ; i limiti vel_max = 4000
      DIV  1000         ;         vel_min = 300
      ST   VEL_TMP      ;
      GT   4000
      JMPC LIMIT_S
      LD   VEL_TMP
      LT   300
      JMPC LIMIT_I
      LD   VEL_TMP
      ST   VELOCITA
      RET
LIMIT_S:
      LD   4000
      ST   VELOCITA
      RET
LIMIT_I:
      LD   300
      ST   VELOCITA
      RET
;
;
; Controlla se le condizioni per il movimento sono valide
;
CECK_FC:
      LDN  DIR           ; (!DIR * !FC_CW) + (!DIR * !FC_CCW_IN1)
      ANDN FC_CW            ;
      OR(  DIR
      ANDN FC_CCW
      )
      JMPC NO_FC
      LD   0             ; se finecorsa ferma motore
      ST   ON_MOTORE
      LD   1
      RET
NO_FC:                    ; controlla fault
      LD   FAULT
      EQ   0
      JMPC NOFAULT
      LD   0             ; se fault ferma motore
      ST   ON_MOTORE
      ST   DRIVE_OK
      LD   1
      RET
NOFAULT:
      LD   0
      RET
END
```